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CLAIMS

[Claim(s)]

- [Claim 1] The memory control unit characterized by to have a logical-memory equipment relocation means store data in the physical store of a relocation place continuously while a data processor rearranges said logical-memory equipment to said physical store based on the index defined beforehand in the memory control unit which arranges the logical memory equipment which performs direct access to the physical store which actually memorizes data, and controls the data transfer between said data processors and said physical stores.
- [Claim 2] In the memory control unit with which a data processor controls the data transfer between matching, said data processor, and said physical store for the physical store which actually remembers data to be logical memory equipment which performs direct access An access information extraction means to extract the access information to the logical memory equipment of a data processor as an index during employment of control of said data transfer, The memory control unit characterized by having a logical memory equipment relocation means to store data in the physical store of a relocation place continuously while rearranging said logical memory equipment to said physical store based on said index.
- [Claim 3] The memory control unit with which said access information is characterized by including the access frequency information from said data processor to said logical memory equipment in a memory control unit according to claim 2.
- [Claim 4] The memory control unit with which said access information is characterized by including the access pattern information from said data processor to said logical memory equipment in a memory control unit according to claim 2 or 3.
- [Claim 5] The memory control unit characterized by said index being the dependability for which said logical memory equipment is asked in a memory control unit according to claim 1.
- [Claim 6] The memory control unit characterized by providing an index presentation means to show said index to either of claim 1 to claims 5 in the memory control unit of a publication at a customer engineer, and a relocation directions reception means to receive the relocation directions from a customer engineer.
- [Claim 7] The memory control unit characterized by providing a relocation directions reception means to receive the relocation directions from a data processor in a memory control unit given in either of claim 1 to claims 5.
- [Claim 8] The memory control unit characterized by providing a relocation necessity decision means to determine the necessity of relocation as either of claim 1 to claims 5 in the memory control unit of a publication based on said index.
- [Claim 9] When the logical memory equipment under relocation has access from a data processor in the memory control unit of a publication at either of claim 1 to claims 8, The completion field of relocation and relocation incomplete field of logical memory equipment under relocation are identified. The memory control unit characterized by providing further the access location change means which will be made to access the logical memory equipment of a relocation place if said access location is said completion field of relocation, and will be made to access the logical memory equipment concerned if said access location is said relocation incomplete field.

[Claim 10] It is the store system characterized by for said memory control unit to acquire the access situation by said data processor in the store system which has the memory control unit which controls the data transfer between two or more physical stores for holding the data of the logical store which a data processor recognizes for a data access, and said two or more physical units and data processor, and to move the data of said logical store to the 2nd physical store from the 1st physical store based on said access situation.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the memory control unit which can improve the dependability of the memory control unit which can improve the access engine performance with the case of a sequential access, or a random accelerator even when a hit ratio is low, and data in more detail about a memory control unit. Especially this invention is useful to the store subsystem constituted by the highly efficient disk unit, its highly efficient disk unit, and disk controller of the disk array sense, and the information processing system constituted by the store subsystem and data processor.

[0002]

[Description of the Prior Art] The paper "D. Patterson, Gibson, and R.H.Kartz:A Case for Redundant Arrays of Inexpensive Disks (RAID), ACM SIGMOD Conference, Chicago and IL, (June 1988) pp.109-116" announced in the "ACM SIGMOD" meeting held in University of Illinois of Chicago is indicating the technique about the data arrangement on a disk array.

[0003] Moreover, in JP-7-84732A, the technique of using a part of disk unit like a disk cache is indicated. It specifically divides into the temporary field which stores data for a disk unit temporarily, and the field which finally writes in data, and duplex writing of the updating data is once carried out to a temporary field, without generating parity, they carry out parity generation asynchronous, and are written in the last field.

[0004] On the other hand, the technique of changing the RAID level holding data dynamically by the difference in access frequency is indicated by the electric information American Communications Association technical research report "DE 95-68 (others [Motegi]: the performance evaluation at the time of disk failure of the disk array using Hot Mirroring, December, 1995, electric information American Communications Association technical report Vol.95-No.407, pp.19-24). By dividing a disk unit into the part of RAID1 configuration, and the part of RAID5 configuration, and specifically changing the storing location of data dynamically so that data with light access may be preferentially stored in the part of RAID1 configuration, the data with high access frequency are stored in the part of RAID1 configuration, and what has low access frequency can be stored in the part of RAID5 configuration. According to this technique, it is possible to make the physical disk equipment with which the physical disk equipment with which memory capacity differs from RAID level intermingled within a store subsystem, and the data in logical disk equipment can be stored in the physical disk equipment of arbitration based on indexes, such as that access frequency, access pattern, etc. Moreover, a storing location can also be dynamically changed so that data with high access frequency may be stored in more nearly high-speed physical disk equipment. In addition, the disk array of RAID1 writes the duplicate in the subdisk unit called a mirror to the write-in data from a data processor, and secures the dependability of data. Since redundancy data are the duplicate of the original data, the overhead of redundancy data origination is small and the access engine performance is good. However, the utilization ratio of physical storage is as low as 50%. On the other hand, the disk array of RAID5 creates the redundancy data called parity to two or more write-in data from a data processor. Since the data before updating and the parity before updating need to be led,

the overhead of redundancy data origination is large to parity creation time, and the access engine performance is bad to it. However, in order to create one parity to two or more data, the utilization ratio of storage is high compared with RAID1.

[0005]

[Problem(s) to be Solved by the Invention] With the above-mentioned conventional technique, in order to change the storing location of data by the data unit to access, on the logical disk equipment with which a data processor performs direct access, data [****] will be discontinuous on the physical disk equipment which actually memorizes data. For this reason, in the case of the sequential access which carries out read/write of a series of data, in fact, two or more data are gathered and there is a trouble which stops being able to carry out read/write and causes access performance degradation.

[0006] Many of data which the access pattern moved with the random accelerator at the part of RAID1 configuration when a hit ratio was low in order to write light data in the part of RAID which moved data judged that access frequency is low on the other hand at every light with conventional technique of the above-mentioned report "DE 95-68" to part of RAID5 from part of RAID1 configuration configuration, and was vacant 1 configuration will be again returned to the part of RAID5 configuration. For this reason, when a hit ratio is low, the improvement in the access engine performance cannot be expected, but has the trouble that the overhead of processing which moves data conversely causes access performance degradation.

[0007] Moreover, with the above-mentioned conventional technique, there is a trouble which is not taken into consideration at all about improvement in the dependability of data.

[0008] Then, with the case of a sequential access, or a random accelerator, the 1st purpose of this invention is to offer the memory control unit which can improve the access engine performance, even when a hit ratio is low. Moreover, the 2nd purpose of this invention is to offer the memory control unit which can improve the dependability of data.

[0009]

[Means for Solving the Problem] In the 1st viewpoint, a data processor arranges this invention to the physical store which actually memorizes data for the logical memory equipment which performs direct access. In the memory control unit which controls the data transfer between said data processors and said physical stores While rearranging said logical memory equipment to said physical store based on the index defined beforehand, the memory control unit characterized by having a logical memory equipment relocation means to store data in the physical store of a relocation place continuously is offered. In the memory control unit by the 1st viewpoint of the above, the storing location of data is not changed by the data unit to access, relocation to physical storage is performed for logical memory equipment as a unit, and data are continuously stored in the physical storage of a relocation place. Therefore, also in the case of a sequential access, the access engine performance can be improved. Moreover, the storing location of data is not changed at every light, but since said relocation is performed based on the index defined beforehand, even when a hit ratio is low, the access engine performance can be improved with a random accelerator.

[0010] In the 2nd viewpoint, this invention matches the physical store which actually remembers data to be logical memory equipment with which a data processor performs direct access. In the memory control unit which controls the data transfer between said data processors and said physical stores An access information extraction means to extract the access information to the logical memory equipment of a data processor as an index during employment of control of said data transfer, While rearranging said logical memory equipment to said physical store based on said index, the memory control unit characterized by having a logical memory equipment relocation means to store data in the physical store of a relocation place continuously is offered. In the memory control unit by the 2nd viewpoint of the above, the storing location of data is not changed by the data unit to access, relocation to physical storage is performed for logical memory equipment as a unit, and data are continuously stored in the physical storage of a relocation place. Therefore, also in the case of a sequential access, the access engine performance can be improved. Moreover, since the storing location of data is not changed at every light, but access information is extracted and said relocation is performed, using it

statistically, even when a hit ratio is low, the access engine performance can be improved with a random accelerator.

[0011] In the 3rd viewpoint, this invention offers the memory control unit characterized by said access information including the access frequency information from said data processor to said logical memory equipment in the memory control unit of the above-mentioned configuration. In the memory control unit by the 3rd viewpoint of the above, logical memory equipment with high access frequency is rearrangeable to more nearly high-speed physical storage. Therefore, the access engine performance can be improved.

[0012] In the 4th viewpoint, this invention offers the memory control unit characterized by said access information including the access pattern information from said data processor to said logical memory equipment in the memory control unit of the above-mentioned configuration. In the memory control unit by the 4th viewpoint of the above, logical memory equipment with the high ratio of a sequential access is rearrangeable to physical storage with the more high sequential access engine performance. Therefore, the access engine performance can be improved.

[0013] In the 5th viewpoint, this invention offers the memory control unit characterized by said index being the dependability for which said logical memory equipment is asked in the memory control unit of the above-mentioned configuration. In the memory control unit by the 5th viewpoint of the above, that it is reliable can rearrange the logical memory equipment called for to more reliable physical storage. Therefore, the dependability of data can be improved.

[0014] In the 6th viewpoint, this invention offers the memory control unit characterized by providing an index presentation means to show a customer engineer said index, and a relocation directions reception means to receive the relocation directions from a customer engineer in the memory control unit of the above-mentioned configuration. In the memory control unit by the 6th viewpoint of the above, since a customer engineer can input relocation directions, said relocation can be performed very flexibly.

[0015] In the 7th viewpoint, this invention offers the memory control unit characterized by providing a relocation directions reception means to receive the relocation directions from a data processor in the memory control unit of the above-mentioned configuration. In the memory control unit by the 7th viewpoint of the above, since a data processor can input relocation directions, a customer engineer can perform said relocation under the advanced conditions which cannot be judged.

[0016] In the 8th viewpoint, this invention offers the memory control unit characterized by providing a relocation necessity decision means to determine the necessity of relocation based on said index in the memory control unit of the above-mentioned configuration. In the memory control unit by the 8th viewpoint of the above, in order for a memory control unit to make a self-decision of the relocation directions, it is not necessary to apply a burden to a customer engineer or a data processor.

[0017] When this invention has access from a data processor in the logical memory equipment under relocation in the memory control unit of the above-mentioned configuration in the 9th viewpoint, The completion field of relocation and relocation incomplete field of logical memory equipment under relocation are identified. If said access location is said completion field of relocation, the logical memory equipment of a relocation place will be made to access, and if said access location is said relocation incomplete field, the memory control unit characterized by providing the access location change means made to access the logical memory equipment concerned will be offered. In the memory control unit by the 9th viewpoint of the above, since the completion field of relocation and relocation incomplete field of logical memory equipment under relocation are identified and the access location from a data processor is changed, while employing the data transfer between a data processor and a physical store, it is rearrangeable.

[0018] Two or more physical stores for this invention to hold the data of the logical store which a data processor recognizes for a data access in the 10th viewpoint. In the storage system which has the memory control unit which controls the data transfer between said two or more physical units and data processors said memory control unit. The access situation by said data processor is acquired, and the storage process defined system characterized by moving the data

of said logical store to the 2nd physical store from the 1st physical store based on said access situation is offered. In the memory control unit by the 10th viewpoint of the above, since the data of logical memory equipment are moved to the 1st to 2nd physical store according to the access situation by the data processor, the access engine performance can be improved.

[0019]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained. In addition, thereby, this invention is not limited.

[0020] - 1st operation gestalt - The 1st operation gestalt extracts the access information of each logical disk equipment with a memory control unit, and shows it to a customer engineer through SVP (service processor), and the relocation directions of a customer engineer based on this access information perform relocation to the physical disk equipment of logical disk equipment.

[0021] Drawing 1 is the block diagram of the information processing system containing the memory control unit concerning the 1st operation gestalt of this invention. This information processing system 1 has come to connect a data processor 100, a memory control unit 104, one or more physical disk equipments 105, and SVP111.

[0022] Said data processor 100 has CPU101, the primary storage 102, and the channel 103.

[0023] Said memory control unit 104 has one or more directors 106, cache memory 107, directory 108, nonvolatile memory 109, the nonvolatile memory management information 110, the information 300 corresponding to logic physics, the logical disk equipment information 400, and access information 500. Said director 106 performs data transfer between the channel 103 of a data processor 100, the data transfer between physical disk equipment 105 and the channel 103 of a data processor 100, and said cache memory 107, and data transfer between said cache memory 107 and physical disk equipment 105. Data with the high access frequency in physical disk equipment 105 are loaded to said cache memory 107. Said director 106 performs this load processing. The examples of the data to load are the data for access of CPU101 of a data processor 100, this data for access, data with the near storing location on physical disk equipment 105, etc. Said directory 108 stores the management information of said cache memory 107. Said nonvolatile memory 109 loads data with the high access frequency in physical disk equipment 105 like said cache memory 107. Said nonvolatile memory management information 110 stores the management information of said nonvolatile memory 109. Said information 300 corresponding to logic physics is information which shows the logical disk equipment (200 of drawing 2) arranged at the location and each physical disk equipment 105 on the physical disk equipment 105 with which each logical disk equipment (200 of drawing 2) is arranged. Calculation of the storing field on the physical disk equipment 105 of the data for access of CPU101 of a data processor 100 etc. is performed using this information. Said logical disk equipment information 400 shows conditions, such as access propriety of each logical disk equipment (200 of drawing 2). Said access information 500 is the information on the access frequency of each logical disk equipment (200 of drawing 2), an access pattern, etc.

[0024] The information 300 and the logical disk information 400 corresponding to logic physics are recorded on a non-volatilized medium, in order to prevent disappearance by power off etc.

[0025] Said physical disk equipment 105 consists of a medium which records data, and equipment which write the recorded data.

[0026] Said SVP111 receives an input of the presentation to the customer engineer of access information 500 and the relocation directions 620 from a customer engineer. Moreover, presentation to customer engineers, such as a fault condition of the dispatch of directions and information processing system 1 to the information processing system 1 from a customer engineer, is performed.

[0027] Drawing 2 is drawing showing the relation of logical disk equipment 200 and physical disk equipment 105. Logical disk equipment 200 is an apparent disk unit in which CPU101 of a data processor 100 carries out direct access, and corresponds with the physical disk equipment 105 with which the data for access are actually stored. The data on logical disk equipment 200 are continuously arranged on physical disk equipment 105 in consideration of the sequential access. When the physical disk equipment 105 with which the data of logical disk equipment 200 are

arranged is a disk array configuration, this logical disk equipment 200 corresponds with two or more physical disk equipments 105. Moreover, the capacity of physical disk equipment 105 is larger than logical disk equipment 200, and when the data of two or more logical disk equipments can be stored in one physical disk equipment 105, this physical disk equipment 105 corresponds with two or more logical disk equipments 200. Correspondence of this logical disk equipment 200 and physical disk equipment 105 is managed for said information 300 corresponding to logic physics. For example, when CPU101 of a data processor 100 leads the data 201 of logical disk equipment 200, based on the information 300 corresponding to logic physics, it asks for the physical disk equipment 105 corresponding to logical disk equipment 200 with a memory control unit 104, and asks for the data storage location 202 in the field of the physical disk equipment 105, and data transfer is performed.

[0026] Drawing 3 is drawing showing the information 300 corresponding to logic physics. The information 300 corresponding to logic physics consists of logical disk configuration information 310 and physical disk configuration information 320. Said logical disk configuration information 310 is the information about the field on the physical disk equipment 105 with which each logical disk equipment 200 is arranged, and when asking for the physical disk equipment 105 which corresponds from logical disk equipment 200, it is used. On the other hand, said physical disk configuration information 320 is the information about the logical disk equipment 200 arranged at each physical disk equipment 105, and when asking for the logical disk equipment 200 which corresponds from physical disk equipment 105, it is used.

[0029] As for said logical disk configuration information 310, only the number of logical disk equipment 200 has the group of the physical disk device group 311, the RAID configuration 312, and a starting position 313. Said physical disk device group 311 is information which shows the physical disk equipment 105 with which the logical disk equipment 200 concerned is arranged. Said RAID configuration 312 shows said physical disk device group's 311 RAID level. Said starting position 313 shows the head location where the logical disk equipment 200 concerned is arranged on physical disk equipment 105.

[0030] As for said physical disk configuration information 320, only the number of physical disk equipment 105 has the logical disk device group 321. Said logical disk device group 321 shows the logical disk equipment 200 arranged at the physical disk equipment 105 concerned.

[0031] Drawing 4 is drawing showing the logical disk information 400. As for the logical disk information 400, only the number of logical disk equipment 200 has the logical disk condition 401 and the completion pointer 402 of relocation. Said logical disk condition 401 expresses the condition of the logical disk equipments 200 "normal", "lock out", "under", etc. ["under a format and relocation"] Said completion pointer 402 of relocation is effective information only while said logical disk condition 401 "is rearranging", and the head location of the field which has not yet finished relocation processing is shown, the next location 200, i.e., logical disk equipment concerned, of the field which has completed relocation processing of the logical disk equipment 200 concerned. In access to the field before the completion pointer 402 of relocation, it must access to the physical disk equipment 105 after relocation at the time of the data access "under relocation." On the other hand, in access to the field after completion pointer of relocation 402, it must access to the physical disk equipment 105 before relocation.

[0032] Drawing 5 expresses access information 500. As for access information 500, only the number of logical disk equipment 200 has the access frequency information 501 and the access pattern information 502. Refer to this access information 500 for a memory control unit 104, a data processor 100, or SVP111. Said access frequency information 501 manages the count of access to the logical disk equipment 200 concerned per unit time amount. This access frequency information 501 is used as an index which asks for the high thing or the low thing of access rate of the sequential access to the logical disk equipment 200 concerned, and random access. This access pattern information 502 has many sequential accesses, and rearranging to physical disk equipment 105 with the more high sequential engine performance uses it as an index which asks for desirable logical disk equipment 200.

[0033] Next, actuation of a memory control unit 104 is explained. Drawing 6 is drawing which

expressed actuation of a memory control unit 104 to the detail. First, the actuation at the time of read/write processing is explained. In case a director 106 usually performs read/write processing, he receives the directions 600 from CPU from CPU101 via a channel 103. The directions 600 from this CPU include the assignment information 1 which specifies the logical disk equipment 200 with which the record for a lead (or light) is memorized, and the assignment information 2 which specifies the location (a truck, a sector, record) in the logical disk equipment 200 with which the record for a lead (or light) is memorized. A director 106 is access location calculation processing (610) on physical disk equipment, and computes the access location on physical disk equipment 105 using the directions 600 from said CPU, and the information 300 corresponding to logic physics. This physical disk drive-access location calculation processing (610) is explained in full detail with reference to drawing 8 later. Then, for example by lead processing, the data of the data storage location 202 on the computed physical disk equipment 105 are read out on cache memory 107, it considers as data 201, and the read-out data 201 is transmitted to a primary storage 102 through a channel 103.

[0034] Next, extraction processing of access information 500 is explained. At the time of access of the read/write processing from CPU101, a director 106 updates the access information 500 of the logical disk equipment 200 for access. Extraction of the access frequency information 501 counts up the internal counter at every access, and judges access frequency from said internal counter at the time of access after access progress of fixed time amount or the count of fixed.

[0035] Next, the relocation directions 620 are explained. A customer engineer examines the need for relocation of each logical disk equipment 200 with reference to the access information 500 shown through SVP111. If there is logical disk equipment 200 which opted for relocation as a result of this examination, the relocation directions 620 will be issued to a memory control unit 104 through SVP111. These relocation directions 620 consist of directions information 1-2 which

specifies two logical disk equipments 200 for relocation. The contents of examination which a customer engineer performs are the same as that of logical disk equipment relocation necessity decision processing (910) in which it explains with reference to drawing 10 with the 3rd operation gestalt mentioned later.

[0036] Next, logical disk equipment relocation processing (630) is explained. A director 106

performs logical disk equipment relocation processing (630) between two specified logical disk equipments 200 in response to said relocation directions 620. Drawing 7 is the processing flow Fig. of the logical disk equipment relocation processing section 630. At step 700, the logical disk condition 401 of two logical disk equipments 200 of having been specified of the logical disk information 400 is set up "during relocation." At step 701, the completion pointer 402 of relocation of two logical disk equipments 200 with which it was specified of the logical disk information 400 is checked, and if relocation of all fields is not completed, and it progressed to step 703 and has completed, it will progress to step 707.

[0037] At step 703, data transfer from physical disk equipment 105 to a cache memory 107 top is performed to the data for 1 time of the batch of relocation processing from the data location which the completion pointer 402 of relocation shows. Here, the amount of data for 1 time of a batch is determined as the least common multiple of each amount of data corresponding to one redundancy data of two logical disk equipments 200 for relocation. For example, if it rearranges between the logical disk equipment 200 of RAID5, and the logical disk equipment 200 of RAID1, since the amount of data corresponding to one redundancy data of the logical disk equipment 200 of RAID1 is "1", the amount of data for 1 time of a batch will be determined as the amount of data corresponding to one redundancy data of the logical disk equipment 200 of RAID5, i.e., the amount of data corresponding to one parity.

[0038] At step 704, when the relocation place logical disk equipment 200 of each logical disk equipment 200 for relocation is the thing of RAID level which has parity, parity is generated to

the data 201 for 1 time of the batch for [on cache memory 107] relocation. At step 705, the parity created at the data 201 and said step 704 for 1 time of a batch for relocation is written in the physical disk equipment 105 of a relocation place. [on cache memory 107] At step 706, the completion pointer 402 of relocation is carried forward by 1 time of the batch. And it returns to said step 702.

[0039] In addition, in the above-mentioned step 703, 704, it transmits and doubles also to nonvolatile memory 109, and data and parity prevent data missing by the cache failure. This reason at the time of the writing in the above-mentioned step 705 For example, the inside of the data of the 1st logical disk equipment 200 and the 2nd logical disk equipment 200. Supposing the data on cache memory 107 become access impossible according to a failure in the phase which wrote the data of the 1st logical disk equipment 200 in physical disk equipment 105 (physical disk equipment 105 with which the dimension is arranged at the 2nd logical disk equipment 200) It is because the data of the 2nd logical disk equipment 200 which writing has not ended disappear (the data of the 1st logical disk equipment 200 will be overwritten as mentioned above by the physical disk equipment 105 with which the dimension is arranged at the 2nd logical disk equipment 200).

[0040] At step 707, the information 300 corresponding to logic physics is updated. That is, the logical disk configuration information 310 and the physical disk configuration information 321 are changed. At step 708, the logical disk condition 401 of the logical disk information 400 is returned to the original condition, and relocation processing (630) is ended.

[0041] Next, physical disk drive-access location calculation processing (610) is explained. Drawing 8 is the processing flow Fig. of the physical disk drive-access location calculation processing section 610. if it confirms whether the logical disk condition 401 of the logical disk equipment 200 for access of the logical disk information 400 "is rearranging" and becomes "during relocation" about it at step 800 -- step 801 -- progressing -- "under relocation --" it is -- " -- if there is nothing, it will progress to step 803.

[0042] The completion pointer 402 of relocation and the access data location of the logical disk equipment 200 for access of the logical disk information 400 are compared, if an access data location becomes after the location which the completion pointer 402 of relocation points out, it will progress to step 802, and if an access data location becomes a front [location / which the completion pointer 402 of relocation points out], it will progress to step 803 at step 801.

[0043] At step 802, the logical disk equipment 200 of the relocation place of the logical disk equipment 200 concerned is made applicable to access. And it progresses to step 804.

[0044] At step 803, the logical disk equipment 200 concerned is made applicable to access.

[0045] At step 804, the access location on the physical disk equipment 105 corresponding to the logical disk equipment 200 for access is computed using the information 300 corresponding to logic physics.

[0046] According to the information processing system 1 and the memory control unit 104 concerning the above operation gestalt [1st], logical disk equipment with high access frequency is rearrangeable to more nearly high-speed physical disk equipment with the decision of a customer engineer based on access information 500. Moreover, logical disk equipment with the high ratio of a sequential access is rearrangeable to physical disk equipment with the more high sequential access engine performance. Therefore, the access engine performance can be improved.

[0047] - The operation gestalt of the 2nd operation gestalt-above 1st is transformed, and access information 500 is shown to a data processor 100 from a memory control unit 104, and a data processor 100 determines relocation necessity and you may make it take out relocation directions (about [620]) to a memory control unit 104.

[0048] - 3rd operation gestalt - The 3rd operation gestalt receives relocation directions neither from SVP111 nor a data processor 100, but a memory control unit 104 makes a self-decision.

[0049] Drawing 9 is drawing which expressed actuation of a memory control unit 104 to the detail. The difference from the 1st operation gestalt (drawing 6) is that the logical disk relocation necessity decision processing section 910 issues the relocation directions 620.

[0050] Drawing 10 is the processing flow Fig. of the above-mentioned logical disk relocation

necessity decision processing section 910. A director 106 performs this logical disk relocation necessity decision processing (910) by inspecting the access information 500 of each logical disk equipment 200 a fixed period. If there is [whether there is logical disk equipment / low speed / the physical disk equipment 105 which access frequency exceeds default value and is arranged at step 1000 with reference to the access frequency information 501 on access information 500 / equipment / comparatively / (this is hereafter called 1st candidate logical disk equipment) 200, and] logical disk equipment 200 which checks and corresponds, it will progress to step 1001, and if there is nothing, it will progress to step 1005.

[0051] At step 1001, it confirms whether the ratio of a sequential access is beyond default value, with reference to the access pattern information 502 on said 1st candidate logical disk equipment 200, if it is not beyond default value, it will progress to step 1002, and with default value [beyond], it progresses to step 1004.

[0052] At step 1002, with reference to the access frequency information 501 on the logical disk equipment 200 arranged at physical disk equipment 105 more nearly high-speed than said 1st candidate logical disk equipment 200, if check and it is [whether access frequency has logical disk equipment 200 below default value (this is hereafter called 2nd candidate logical disk equipment), and], it will progress to step 1003, and if there is nothing, it will progress to step 1005.

[0053] It determines that relocation processing (630) is required between said 1st candidate logical disk equipment 200 and said 2nd candidate logical disk equipment 200, and the relocation directions 620 are taken out with step 1003. And processing is ended.

[0054] At step 1004, with reference to the access pattern information 502 on the logical disk equipment 200 arranged at physical disk equipment 105 with the sequential engine performance higher than said 1st candidate logical disk equipment 200, if check and it is [whether the ratio of a sequential access has logical disk equipment 200 below default value (this is hereafter called 2nd candidate logical disk equipment), and], it will progress to said step 1003, and if there is nothing, it will progress to said step 1002.

[0055] At step 1005, it is determined that relocation processing (630) of logical disk equipment 200 is unnecessary. And processing is ended.

[0056] According to the information processing system 1 and the memory control unit 104 concerning the above operation gestalt [3rd], based on access information 500, logical disk equipment with high access frequency is rearrangeable to more nearly high-speed physical disk equipment automatically. Moreover, logical disk equipment with the high ratio of a sequential access is rearrangeable to physical disk equipment with the more high sequential access engine performance. Therefore, the access engine performance can be improved.

[0057] - 4th operation gestalt-above-mentioned the 1) - the 3rd operation gestalt -- deforming - access information 500 -- replacing with -- or -- in addition, the dependability required of logical disk equipment 200 may be used for the index of relocation processing necessity decision. If dependability is used for an index, the dependability of the data on logical disk equipment 200 can be raised.

[0058]

[Effect of the Invention] According to the memory control unit of this invention, with the case of a sequential access, or a random accelerator, even when a hit ratio is low, the access engine performance can be improved. Moreover, according to the memory control unit of this invention, the dependability of data can be improved.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

- [Drawing 1] It is the block diagram of the information processing system containing the memory control unit concerning the 1st operation gestalt of this invention.
- [Drawing 2] It is the explanatory view of the correspondence relation between logical disk equipment and physical disk equipment.
- [Drawing 3] It is the configuration instantiation Fig. of the information corresponding to logic physics.
- [Drawing 4] It is the configuration instantiation Fig. of logical disk information.
- [Drawing 5] It is the configuration instantiation Fig. of access information.
- [Drawing 6] It is the block diagram showing actuation of the memory control unit in the 1st operation gestalt of this invention.
- [Drawing 7] It is the processing flow Fig. of the logical disk equipment relocation processing section.
- [Drawing 8] It is the processing flow Fig. of the physical disk drive-access location calculation processing section.
- [Drawing 9] It is the block diagram showing actuation of the memory control unit in the 3rd operation gestalt of this invention.
- [Drawing 10] It is the processing flow Fig. of the logical disk equipment relocation necessity decision processing section.
- [Description of Notations]
- 1 --- Information Processing System
- 100 --- Data processor
- 101 --- CPU
- 102 --- Primary storage
- 103 --- Channel
- 104 --- Memory control unit
- 105 --- Physical disk equipment
- 106 --- Director
- 107 --- Cache memory
- 108 --- Cache directory
- 109 --- Nonvolatile memory
- 110 --- Nonvolatile memory management information
- 111 --- SVP
- 200 --- Logical disk equipment
- 201 --- Data
- 202 --- Data storage location
- 300 --- Information corresponding to logic physics
- 400 --- Logical disk information
- 500 --- Access information
- 600 --- Directions from CPU
- 610 --- The access location calculation processing section on physical disk equipment

- 620 --- Directions information
- 630 --- Logical disk equipment relocation processing section
- 910 --- Logical disk relocation necessity decision processing section

[Translation done.]

13

11 処理単位分だけ再配置完了ポインタ402を進める。そして、前記ステップ702に遷る。

【0039】なお、上記ステップ703、704において、データおぼろげリテリィは、不揮発性メモリ109にも転送して二重化し、キャッシュ履歴によるデータ消失を防ぐ。この理由は、上記ステップ705での書き込み時に、例えば、第1の論理ディスク装置200と第2の論理ディスク装置200のデータのうち、第1の論理ディスク装置200のデータを物理ディスク装置105（元は第2の論理ディスク装置200に配置されていた物理ディスク装置105）へ書き込んだ段階で障害によりキャッシュメモリ107上のデータがアクセス不能になったとすると、書き込みが終了してない第2の論理ディスク装置200のデータが消失するからである（元は第2の論理ディスク装置200に配置されていた物理ディスク装置105には、上記のように第1の論理ディスク装置200のデータが上書きされている）。

【0040】ステップ707では、論理物理対応情報310を更新する。すなわち、論理ディスク構成情報310と物理ディスク構成情報321を変更する。ステップ708では、論理ディスク情報400の論理ディスク状態401を元の状態に戻し、再配置処理（630）を終了する。

12 10 【0041】次に、物理ディスク装置アクセス位置算出処理（610）を実行する。図8は、物理ディスク装置アクセス位置算出処理610の処理フロー図である。ステップ800では、論理ディスク情報400のうちのアクセス対象論理ディスク装置200の論理ディスク状態401が「再配置中」であるか否かをチェックし、「再配置中」ならばステップ801に進み、「再配置中」でなければステップ803に進む。

13 【0042】ステップ801では、論理ディスク情報400のうちのアクセス対象論理ディスク装置200の再配置完了ポインタ402とアクセスデータ位置とを比較し、アクセスデータ位置が再配置完了ポインタ402の指す位置以後ならばステップ802に進み、アクセスデータ位置が再配置完了ポインタ402の指す位置より前ならばステップ803に進む。

14 【0043】ステップ802では、当該論理ディスク装置200の再配置先の論理ディスク装置200をアクセス対象にする。そして、ステップ804へ進む。

15 【0044】ステップ803では、当該論理ディスク装置200をアクセス対象とする。

16 【0045】ステップ804では、アクセス対象の論理ディスク装置200に付帯した物理ディスク装置105上でのアクセス位置を、論理物理対応情報300を用いて算出する。

17 【0046】以上の第1の実施形態にかかる情報処理システム1および記憶制御装置104によれば、アクセス500の間で記憶制御装置104によれば、アクセス情報500に基づく保守員の判断により、アクセス頻度の高い論理ディスク装置をより高度な物理ディスク装置へ再配置することが出来る。また、シーケンシャルアクセスの比率の高い論理ディスク装置をよりシーケンシャルアクセスの比率の高い物理ディスク装置へ再配置することが出来る。従って、アクセス性能を向上することが出来る。

18 【0047】一第2の実施形態—

19 上記第1の実施形態は、記憶制御装置104がアクセス情報500をデータ処理装置100に提示し、データ処理装置100が再配置要否を決定し記憶制御装置104に再配置指示（620相当）を出すようにしてもよい。

20 【0048】一第3の実施形態—

21 第3の実施形態は、再配置指示をSVP111やデータ処理装置100から受けるのではなく、記憶制御装置104が自己決定するものである。

22 【0049】図9は、記憶制御装置104の動作を詳細に表わした図である。第1の実施形態（図6）との違いは、論理ディスク再配置要否決定処理910が再配置指示620を出すことである。

23 【0050】図10は、上記論理ディスク再配置要否決定処理910の処理フロー図である。この論理ディスク再配置要否決定処理（910）は、ディレクタ106が一定周期で各論理ディスク装置200のアクセス情報500を検査して行う。ステップ1000では、アクセス情報500のアクセス頻度情報501を参照し、アクセス頻度が規定値を超え且つ配置されている物理ディスク装置105が比較的低速なものである論理ディスク装置（以下、これを第1候補論理ディスク装置という）200があるか否かをチェックし、該当する論理ディスク装置200があればステップ1001へ進み、なければステップ1005へ進む。

24 【0051】ステップ1001では、前記第1候補論理ディスク装置200のアクセスパターン情報502を参照し、シーケンシャルアクセスの比率が規定値以上であるか否かをチェックし、規定値以上でなければステップ1002へ進み、規定値以上であればステップ1004へ進む。

25 【0052】ステップ1002では、前記第1候補論理ディスク装置200より高速な物理ディスク装置105に配置されている論理ディスク装置200のアクセス頻度情報501を参照し、アクセス頻度が規定値以下の論理ディスク装置（以下、これを第2候補論理ディスク装置という）200があるか否かをチェックし、あればステップ1003へ進み、なければステップ1005へ進む。

26 【0053】ステップ1003では、前記第1候補論理ディスク装置200と前記第2候補論理ディスク装置200の間で再配置処理（630）が必要であると決定し、再配置指示620を出す。そして、処理を終了する。

13

14 【0054】ステップ1004では、前記第1候補論理ディスク装置200よりシーケンシャル性能の高い物理ディスク装置105に配置されている論理ディスク装置200のアクセスパターン情報502を参照し、シーケンシャルアクセスの比率が規定値以下の論理ディスク装置（以下、これを第2候補論理ディスク装置という）200があるか否かをチェックし、あれば前記ステップ1003へ進み、なければ前記ステップ1002へ進む。

15 【0055】ステップ1005では、論理ディスク装置200の再配置処理（630）は不要であると決定する。そして、処理を終了する。

16 【0056】以上の第3の実施形態にかかる情報処理システム1および記憶制御装置104によれば、アクセス情報500に基づいて自動的に、アクセス頻度の高い論理ディスク装置をより高度な物理ディスク装置へ再配置することが出来る。また、シーケンシャルアクセスの比率の高い論理ディスク装置をよりシーケンシャルアクセス性能の高い物理ディスク装置へ再配置することが出来る。従って、アクセス性能を向上することが出来る。

17 【0057】一第4の実施形態—

18 上記第1〜第3の実施形態を变形して、アクセス情報500に代えて又は加えて、論理ディスク装置200に要求される信頼性を再配置要否決定の指標に用いてもよい。信頼性を指標に用いれば、論理ディスク装置200上のデータの信頼性を向上させることが出来る。

19 【0058】

20 【発明の効果】本発明の記憶制御装置によれば、シーケンシャルアクセスの場合やランダムアクセスでヒット率が低い場合でも、アクセス性能を向上することが出来る。また、本発明の記憶制御装置によれば、データの信頼性を向上することが出来る。

21 【図面の簡単な説明】

22 【図1】本発明の第1の実施形態にかかる記憶制御装置を含む情報処理システムのブロック図である。

23 【図2】論理ディスク装置と物理ディスク装置との対応関係の説明図である。

24 【図3】論理物理対応情報の構成例説明図である。

【図4】

論理ディスク情報

400

図4

図5

アクセス情報

500

論理ディスク
装置の数だけ
アクセス頻度情報
アクセスパターン情報
再配置完了ポインタ
401
402
403
404論理ディスク
装置の数だけ
再配置完了ポインタ
401
402
403
404

14

【図4】論理ディスク情報の構成例説明図である。

【図5】アクセス情報の構成例説明図である。

【図6】本発明の第1の実施形態における記憶制御装置の動作を示すブロック図である。

【図7】論理ディスク装置再配置処理部の処理フロー図である。

【図8】物理ディスク装置アクセス位置算出処理部の処理フロー図である。

【図9】本発明の第3の実施形態における記憶制御装置の動作を示すブロック図である。

【図10】論理ディスク装置再配置要否決定処理部の処理フロー図である。

【符号の説明】

1 ……情報処理システム

100…データ処理装置

101…CPU

102…主記憶

103…チャネル

104…記憶制御装置

105…物理ディスク装置

106…ディレクタ

107…キャッシュメモリ

108…キャッシュディレクトリ

109…不揮発性メモリ

110…不揮発性メモリ管理情報

111…SVP

200…論理ディスク装置

201…データ

202…データ格納位置

300…論理物理対応情報

400…論理ディスク情報

500…アクセス情報

600…CPUからの指示

610…物理ディスク装置上のアクセス位置算出処理部

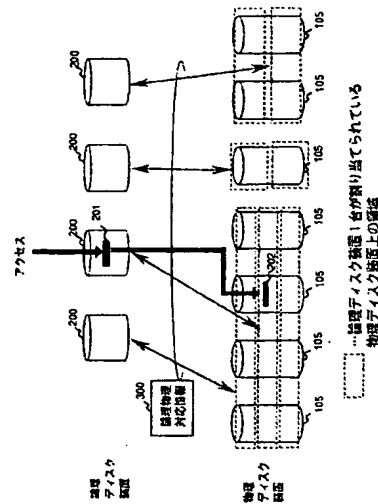
620…指示情報

630…論理ディスク装置再配置処理部

910…論理ディスク再配置要否決定処理部

【図2】

図2



【図3】

図3

論理物理対応情報

3.0.0

論理ディスク構成情報 3.1.0

| | |
|--------|--------------|
| 論理ディスク | 物理ディスク |
| 構成の数のみ | 物理ディスク装置グループ |
| 用意 | RAID構成 |
| | 物理ディスク |

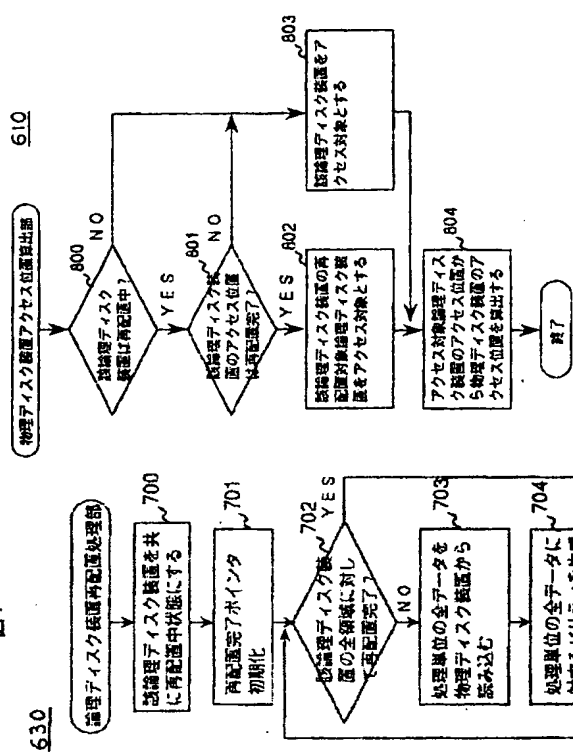
物理ディスク構成情報 3.2.0

| | |
|--------|--------------|
| 物理ディスク | 物理ディスク装置グループ |
| 構成の数のみ | 物理ディスク装置グループ |
| 用意 | 物理ディスク装置グループ |

【8】

图 7

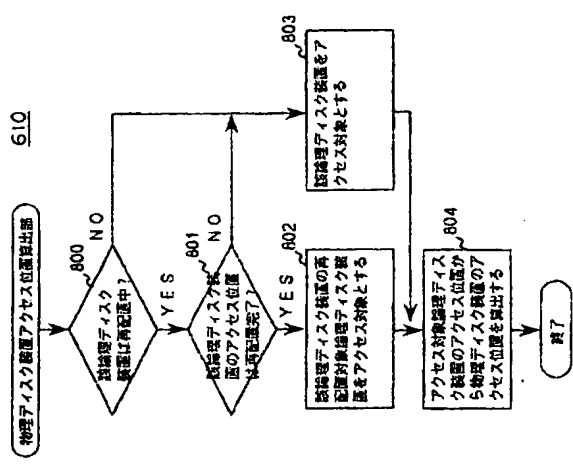
630



【图6】

8
圖

619



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